Journal of Environmental Management 232 (2019) 772–780

Contents lists available at ScienceDirect

Journal of Environmental Management

journal homepage: www.elsevier.com/locate/jenvman

Research article

Preferences among coastal and inland residents relating to managed retreat: Influence of risk perception in acceptability of relocation strategies

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ARTICLE INFO

Keywords:
Climate change
Sea level rise
Relocation
Managed retreat
Choice experiment
Risk perception*JEL classification:*
D6
Q51
Q54
R58

ABSTRACT

Facing sea-level rise, scientists recommend adaptation measures to relocate the most vulnerable assets. This is of particular interest regarding coastal land use management issues. In order to address the acceptability of these measures, we use the choice experiment method to assess residents' preferences for different relocation policy measures that differs according to four attributes. A survey was implemented in the South of France involving 240 people evenly distributed between coastal and hinterland residents. The latent class logit modelling reveals the heterogeneity of preferences via two classes depending on risk perception: residents who may be described as "unaware individualists", generally opposed to relocation, and those who display "informed solidarity", generally in favour of this policy. Furthermore, people the more frequently exposed to the risk reveal an optimism bias.

1. Introduction

Rising sea levels caused by climate change may lead to the submersion of low-lying land, which in turn may result in increased storm damage (Nicholls, 2011). Recurrent flooding in urban areas can pose a significant risk to the safety of local residents, along with increased insurance premiums, reduced property values, and additional costs attached to coastline management. The practice of relocation, i.e. moving people and activities from a vulnerable place to a safe one, should form part of any integrated regional planning policy aimed at dealing with climate change. Many adaptation policies focus on the need to anticipate and reduce vulnerability through managed retreat of seafront buildings and infrastructures. Relocation strategies are generally activated following some form of natural disaster (Hino et al., 2017), representing an opportunity to change (Abel et al., 2011). As recommended by the last IPCC report (2014), a proactive approach should be adopted, allowing the managers of territorial projects to develop resilient pathways. Research institutes and decision support groups, such as the Coastal Services Center of the National Oceanic and Atmospheric Administration (NOAA, 2012) suggest that territorial planning measures should be based on a clear assessment of the vulnerability of the area in question, and must be accompanied both by public risk awareness initiatives and adaptation measures. Such measures call for effective urban planning strategies (Hurlimann et al., 2014), as well as targeted environmental protection initiatives. One example of this is the practice of beach and dune restoration, which helps to create resilient natural protection (Clark, 1998; Titus, 1998; Kelly and Adger, 2000; Abel et al., 2011; Cooper and Pile, 2013).

In some particularly vulnerable areas, it will, in certain circumstances, be necessary to consider relocating inhabitants. Planning for such an eventuality requires knowledge of residents' preferences, behaviors and wishes.

In 2013, the French government launched an experimental relocation program, focusing on five pilot sites (MEDDE, 2015). This was followed by the 2017–2019 national integrated coastline management plan (MEDDE, 2017). At local level, some municipalities and regional authorities have begun work on their own strategies for managing coastal risks, including discussion of possible relocation operations (Guéguen and Renard, 2017). They have also commissioned (among others) socioeconomic studies as a decision support tool.

Despite some positive results in terms of preventing damage and protecting recreational services in beach areas (Cooper and Lemckert, 2012), relocation strategies tend to meet with significant protest, even when confined to a handful of particularly vulnerable properties (Gibbs, 2016). While managed retreat may be viable as a long term strategy, it generates high costs in the short term, and is not particularly attractive to people in relatively dense areas (Bin et al., 2011). Analysis of the conditions in which such policies are acceptable demonstrates the

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https://doi.org/10.1016/j.jenvman.2018.11.104
Received 18 May 2018; Received in revised form 5 November 2018; Accepted 23 November 2018
Available online 05 December 2018

importance of information, previous risk experience, relocation procedures, the characteristics of the relocation zone, and the trust people have in the institutions responsible for delivering such projects (Myatt et al., 2003; Ledoux et al., 2005; French, 2006; Abel et al., 2011; Gibbs, 2016; King et al., 2014).

This article aims to provide a better understanding of the acceptability of relocation policies for main-home residents. It should also provide guidance in development and planning decisions when dealing with rising sea levels. We analyse acceptability using a stated preference economic valuation. This form of valuation makes it possible to study inhabitants' preferences for different relocation measures. We use the choice experiment (CE) method to assess preferences for various attributes (Lancaster, 1966) of relocation procedures (policy implementation date, size of the area concerned and cost of relocation, use and theme of concertation and finally implementation modularity). Given the importance of risk exposure in the process of accepting (or rejecting) adaptive strategies, our economic analysis approaches preferences as they relate to risk. Our survey sample was classified according to whether or not people would be directly affected by relocation, with the questionnaire provided to a sample of residents from coastal and hinterland towns and villages. We hypothesize that preferences vary depending on how far people live from the coast.

We further hypothesize that there are two distinct dimensions to the notion of “distance”. First, and most obviously, there is the question of geographical distance. Coastal residents are physically exposed and vulnerable to risk, and thus directly affected by relocation measures. As shown in the literature, opposition to relocation is mainly due to residents' attachment to their property, neighbourhood, and proximity to the sea (King et al., 2014; Hellequin et al., 2013; Rey-Valette et al., 2018). Hinterland residents have more nuanced viewpoints and are more sensitive to long-term benefits in terms of safety and attractiveness of coastal areas. This is due in particular to their status as beach users (Cooper and Lemckert, 2012). In view of this, there is a potential for optimism bias (Tversky and Kahneman, 1974), whereby people who have the most to lose from flooding risks are in fact the least concerned about such risks. We also need to assess any contradictions between the personal interests of such individuals, and the collective interest, i.e. adapting the area to deal with the effects of climate change.

The second dimension is the cognitive “distance” from flooding risks. Preference heterogeneity may also be explained by different perceptions of risk and levels of knowledge. The role played by perception in risk awareness and the acceptance of management measures is a common theme in risk-related research (Lupton, 1999; Slovic, 2000). These aspects are particularly present in the field of climate change, which is a long-term risk with significant uncertainties, calling for specific learning and management processes (Haasnoot et al., 2013). Our valuation helps to establish the scale at which people feel concerned by coastal risks, and the spatial area considered suitable to receive funding and relocation management.

The next part of the paper provides a review of the literature on risk perception concerning the constraints affecting relocation measures, and identifies possible types of bias. After that, we detail the characteristics of our survey protocol. The main results are then presented and discussed in the final section.

2. Perceptions and acceptability of relocation measures

Existing work on perceptions of flood risk shows that directly-concerned residents, i.e. those whose assets must be relocated, are usually opposed to such measures, because they are greatly attached to their properties and coastal amenities (Rey-Valette et al., 2012; King et al., 2014; Hellequin et al., 2013; Touili et al., 2014). In France, despite the implementation in 2007 of procedures to inform potential buyers of risks affecting their property, the demand for seafront housing, which is the most at risk, remains very strong, with no discernible negative effect on prices (Caumont and Fasquel, 2012). Given this, people purchasing such properties (and taking on substantial mortgages) have all the more reason to oppose managed retreat (King et al., 2014). Denial and skepticism tend to be more prevalent among older residents (Myatt et al., 2003; Hellequin et al., 2013; Rey-Valette et al., 2012) particularly since they find it psychologically more difficult to move (King et al., 2014; Rey-Valette et al., 2018).

In addition to contradictory interests, numerous studies have shown the significant effect of risk perception on behaviour. Such perception depends in particular on social and cultural background (Lupton, 1999), previous risk experience, recollections (Slovic, 1987), and media coverage (Kasperson, 2003). Other authors have highlighted the existence of a specific bias known as optimism bias (Tversky and Kahneman, 1974). This bias refers to reduced levels of concern among people most affected by risk, and/or people who put their trust in technical control measures. This optimism may lead people to think that they are less likely to be affected personally by a risk than other members of their community, or other people in similar circumstances. However, optimism bias seems less noticeable when its proponents are compared with people they are close to (Meyer and Delhomme, 2000; Milhabet et al., 2002; Taylor et al., 2014).

In a number of previous works, one explanation given for this bias is attachment to a particular place, which may generate a sense of a safety, whereby residents feel “far away” from any risk (Bonaiuto et al., 1996; Burley et al., 2007).

The importance of a particular place has an emotional, a symbolic and an identity-based dimension to it all at once, and is particularly pronounced when a property is located in close proximity to the sea.

In the case of climate change, these types of perception bias are even more prevalent, because residents have little or no past experience of risk. Perception bias can also be exacerbated by denial resulting from scientific controversies (Spence and Pidgeon, 2010) or status quo biases (Cameron and Shah, 2010; Dutt and Gonzales, 2012). As described in the planned behaviour theory (Ajzen and Fishbein, 1980), this kind of bias is accentuated by the lack of a “feeling of control”.

Acceptability of relocation is heavily affected by recollection of risk, technical and social issues involved, legitimacy of the institutions in charge of the policy, attractiveness of alternative locations (Graham et al., 2013; Taylor et al., 2014; Touili et al., 2014; Ledoux et al., 2005; Myatt et al., 2003), social norms, and the opinions of close relatives (Lo, 2013) the legitimacy of the institutions in charge of the policy.

These considerations may lead to delayed action, and they go some way to explaining the existence of a form of cognitive distance (Taylor et al., 2014; Graham et al., 2014), which should be taken into account when encouraging residents to take voluntary adaptive action.

These factors appear to be absent from a number of previous economic valuations, which focus mainly on the choice between different types of measures (e.g. dykes and relocation (Rulleau et Rey-Valette, 2017)), knowing and learning strategies (Thomas et al., 2015), transparency in the relocation process (Kloos et Baumert, 2015), and post-hurricane resettlement (Bukvic et al., 2015).

The scale at which we analyse different populations will inevitably influence the perceived acceptability of adaptive policy. It is important to ensure a balanced analysis of “NIMBY” opinions from local residents who are directly affected, and the wider coastal community who are interested in making the whole area more resistant to flood risks (Clément et al., 2015).

Indeed, it is in the interest of local residents who are not at risk to support the implementation of relocation measures, as they ensure beaches are maintained (Cooper and Lemckert, 2012), from which they benefit both directly as beach users, and indirectly through the impact of tourism on the local economy. What makes our approach original is that we take into account risk perceptions over a large geographical area. This allows for greater spatial equity, and provides more effective support to decision makers.

The strongest opposition to relocation stems from the change in the way adaptation policies are presented (Glenk and Fisher, 2010).

Whereas in the past, risk management was focused on maintaining the existing coastline, the mobile nature of those coastlines is now openly acknowledged. This calls for both a profound change in attitudes towards nature, as described in the New Ecological Paradigm (Dunlap et al., 2000), and a fundamental shake-up in public action to deal with these new progressive risks.

3. Study site and survey protocol

3.1. Description of the study zone

The coastline of the Occitanie Region on the French Mediterranean coast is one of the largest open bays in Europe. There is more or less an equal split between urban beaches, where retreat is restricted by urbanization, and more resilient natural beaches (Brunel, 2010). The pilot zone for our research is located in the SCOT territory (French: Schéma de Cohérence Territoriale) around Béziers, which has around 270,000 residents, spread across 87 towns and villages. The coastal settlements in this area are among the most vulnerable to coastal erosion in the whole of the region (MIAL-LR, 2003). The SCOT is made up of municipalities whose size and distance from the coast vary, but with largely shared policies in terms of housing, mobility, land use development etc. As shown in Fig. 1 below, two coastal towns were studied, the seaside resort of Valras-Plage and Vendres, which comprises a tourist district by the seaside and an old village further inland. To test our hypothesis that preferences vary as a function of properties' distance from the coast, we also included three towns located further inland: Béziers, the economic capital of the SCOT territory, located 15 km from the sea, Murviel-lès-Béziers (29 km), and Saint Chinian (40 km), both typical of hinterland agricultural communities.

3.2. Questionnaire and completion method

The Choice Experiment (CE) method was used to identify respondents' preferences for different hypothetical coastal relocation strategies. The questionnaire was designed for main-home residents in coastal and non-coastal municipalities within the SCOT area.

It is divided into several different parts, with CE valuation questions making up the core of it. Respondents are provided with a set of alternatives of the environmental policy being valued (coastal relocation strategy in this case). Each alternative differs from the others according to the level of attributes that is used to define it (modalities of coastal relocation in this case). Respondents are asked to choose their most preferred option from each set of alternatives, one being a reference situation. These choices provide information on people's preferences. As long as one of the characteristics includes a monetary attribute, it is possible to derive the implicit price (or willingness to pay (WTP) indicator) for changes in the levels of the policy's characteristics.

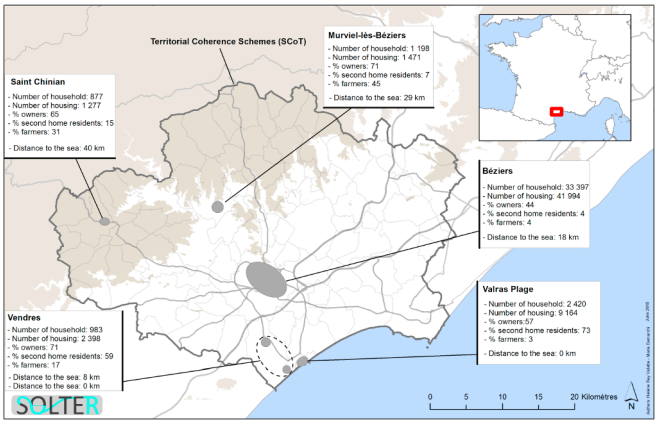

Fig. 1. Study area.

The questionnaire was made up of six modules. The first three modules focused on (i) the dwelling (information about the property), (ii) attachment to the coast, use of beaches, coastal knowledge and (iii) perception of flooding and the related risks (general perception of risks, risk of sea-level rise in their region, perceptions of fairness in managed retreat policies …). This was followed by an oral presentation of hypotheses relating to rising sea levels, current coastline management approaches, and the attributes and levels used to define costal relocation approaches. The CE module was constructed based on valuation questions. Finally, there was a section designed to provide a more precise representation of the modes of relocation used as attributes, and another relating to the socio-demographic characteristics of respondents.

A stratified sampling design was used, to target main-home residents from both costal and hinterland communes. Potential respondents were invited by phone and the questionnaire was completed in rooms made available by the local councils. The study was self-administered in the presence of researchers. The questionnaire took an hour on average. A total of 258 people were surveyed, but some questionnaires were not fully completed. This is a quite small sample since we usually have around 400 answers. It is mainly explained by the difficulties to convene the potential participants to the meeting organised in order to better explain the scenarios and make sure that they all have the same information. However, the sample is large enough against representativeness criteria required by the choice experiment modelling. The answers from 240 respondents were used for this article, spatially balanced between the coast (74 people in Valras-plage and 43 in Vendres) and the hinterland (60 people in Béziers, 34 in Murviel-les-Béziers and 29 in Saint Chinian).

3.3. Definition of attributes and scenarios

In the CE, the so-called “reference” situation was presented as the current situation which does not involve a managed retreat strategy, but a protection strategy through beach nourishment; the alternative scenarios illustrated *hypothetical* relocation policies. This reference situation was defined in collaboration with researchers in geomorphology by transposing the Intergovernmental Panel on Climate Change (IPCC) forecasts to the region. By 2060, if there is no change in the coastline management policy, a progressive 30% reduction in beach size can be expected, together with more frequent severe storms (every 5–6 years). It is also likely that insurance premiums will be reviewed and become proportional to the risk incurred.

Against this backdrop, we selected four attributes in collaboration with the local State services responsible for coastal management to reflect the range of alternative relocation implementation options (Table 1):

1. Dialogue arrangements in implementing the relocation policy, which reflects the extent to which inhabitants are involved (not at all, consulted on the zones to be relocated or consulted on the compensation criteria for relocation);
2. Implementation period which focuses on the implementation period (2015–2013, 2030–2045 or 2045–2060);
3. Policy implementation schedule (in successive stages or one-off); and
4. Cost of the relocation policy. This monetary attribute is defined as the financial contribution of households, giving the relevant spatial size of the associated area. Cost was calculated on the basis of the size of the area to be relocated. Only the extra costs of works (demolition and beach nourishment) were taken into account. They were estimated with the competent State services. In accordance with current practice, we assumed that half the works would be funded by subsidies with the other half being paid for by the municipalities belonging to the SCOT, shared among the tax-paying households. An increase in local tax was proposed as the means by

Table 1
Attributes for relocation scenarios.

Attribute	Description	Levels
Concertation	Concertation arrangements	1. None 2. Consultation on the zones to be relocated 3. Consultation on compensation criteria
Timing	Timing of relocation implementation	1. In the next 15 years (2015–2030) 2.15–30 years (2030–2045) 3.30–45 years (2045–2060)
Schedule	Schedule of relocation implementation	1. One-off 2. In successive stages
Size of the relevant area and additional cost	Size of the relevant area and additional cost	1. Coastal infrastructure (roads, walls, promenades, plays …) for a cost of €10 2. Coastal infrastructure and houses or shops on the seafront for a cost of €100 3. Coastal infrastructure and houses or shops on and behind the seafront for a cost of €200

which to finance this extra expenditure.

On the basis of these attributes and their levels, different combinations of environmental policy were constructed using the "Ngene" software, that generates experimental designs for stated choice surveys. The alternatives were associated into valuation questions (called "choice sets"), each one consisting of three scenarios: the reference situation and two hypothetical relocation policies. We used an efficient fractional factorial design protocol (Rose et al., 2008) which led to 36 possible alternative scenarios, split into 18 relevant choice sets. The latter were then split into three questionnaire versions and distributed randomly to the respondents (Louvière et al., 2000). Each respondent was presented six choice sets.

3.4. Econometric modelling

With the CE method, the valuation approach involves studying the scenario choices made by the respondents and analysing them in terms of preferences. Knowing that the individual utility U_{ij} is expressed as the sum of a deterministic component (V_{ij}) and a random term (ε_{ij}) (such as $U_{ij} = V_{ij} + \varepsilon_{ij}$) and according to the Random Utility Theory (Thurstone, 1927) formalized by McFadden (1974), an alternative j is chosen by individual i when the utility associated with it (U_{ij}) is higher than for all other alternatives $q \neq j$ of the choice set C (Equation (1)):

$$U_{ij} > U_{iq}\ , \forall\ j \neq q \Leftrightarrow (V_{ij} - V_{iq}) > (\varepsilon_{iq} - \varepsilon_{ij}) \quad (1)$$

Based on assumptions regarding the distribution of the random parameters, different discrete choice models may be estimated. The usual one is the logit where the error terms are assumed to follow a Weibull distribution.

In our case, we suppose that the preferences of residents may vary according to their geographical or cognitive distance from the coast and from risk. We therefore opted to estimate a latent-class logit model (LCM) to take into account the hypothesis of preference heterogeneity. The estimated choice probability is then conditioned by the individual i belonging to the class k (Equation (2)):

$$\Pr(i \text{ chooses } j|k) = \exp(\beta_k X_{ij}) / \sum_q \exp(\beta_k X_{iq}) \quad (2)$$

where β is the vector of the parameters to estimate and X is a vector of attributes of choice. The probability that an individual i belongs to the class k may then be expressed as the following Equation (3):

$$H_{ik} = \exp(\delta_k s_i) / \sum_{k=1}^{K} \exp(\delta_k s_i) \quad (3)$$

where s_i denotes a set of individual i characteristics that enter the model for class membership (Greene and Hensher, 2003). Error distributions for Equation (3) are assumed to be of type I and the choice likelihood for individual i is then expressed as the following joint probability (Equation (4)):

Table 2
Statistical criteria used to determine the optimal number of classes.

Number of classes	AIC	BIC	delta AIC
1	2649.37		
2	2441.37	2509.91	−208.00
3	2386.48	2491.93	−54.89
4	2267.74	2410.09	−118.74

$$P_i = \sum_{k=1}^{K} H_{ik} P_{i|k} \quad (4)$$

Heterogeneity is expressed between classes and not within each class as it is assumed that individuals in the same class have the same preferences. Such an LCM has the advantage of being based on a joint estimation and allowing "*intuitive interpretation and communication to policymakers*" (Scarpa and Thiene, 2005, p. 426).

Both empirical and statistical considerations should be used to guide the determination of the number of classes k, but conventional rules do not exist and "*judgement and simplicity play a role in the final selection (…)*" (Boxall and Adamowicz, 2002, p. 433). In our case, knowledge of the area and the literature on managed retreat led us to consider two classes. From a strictly statistical viewpoint, a 4-classes model has the BIC (Bayesian Information Criterion) minimised (cf. Table 2). However, the AIC (Akaike Information Criterion) (which is not minimised in any class) shows the greatest improvement going from 1 to 2 classes. We therefore selected the model with two latent classes.

Individual characteristics s_i hypothesized to explain class membership (Equation (3)) may be socio-economic or attitudinal (Birol et al., 2006). We tested numerous socio-economic variables (income, household size, etc.) which proved to be non-significant and several variables relating to risk perception (Table 3). The final model offers two fairly-balanced classes (respectively 52% and 48% of the sample) and noticeably improves the general quality of the estimates. Data were analysed using the R software.

4. Results

4.1. Socio-economic profile of the sample

48% of respondents were native to the area and 54% were women. The average age was 54, but around a third of the sample (32%) was over 65.46% of respondents had remained in education for at least two years after the baccalaureate, a level of education that is higher than the average in the area. This outcome may be explained by the large number of owners (73%) who were included given the nature of the topic because ownership correlates with educational level ($p < 0.05$). Finally, income and educational levels are independent of location; coastal communities have a greater proportion of pensioners (56%) and Béziers has more students (13%).

Table 3
Variables used in the model.

Variable name	Description
Moda2	Concertation about the retreat area
Moda 3	Concertation on the amount of compensation
Period2	Policy implementation in 15–30 years' time
Period3	Policy implementation in 30–45 years' time
Program2	Policy implementation in successive stages
Cost	Cost and size of the retreat area
StormMem	Recollection of violent storms
SLRInf10	Likely risk over the next 10 years
ProbaStorm	High storm probability over the next 15 years
FloodArea	Dwelling located in zone at risk of inundation

4.2. Perceptions and risk awareness

Respondents tended to be aware of flooding risk, with 55% stating that it was a possibility within the next 10 years, and 22% feeling it would subsequently become a significant issue. Denial was exhibited by only 11% of respondents, who felt that rises in sea levels would not be significant, or that forecasts had not been proven. 9% stated that they did not know. The chi-square test shows a significant difference in the answers by location ($p < 0.05$): there was an over-representation of risk awareness in Béziers (65% felt it would occur within the next 10 years) and of denial in Saint Chinian (24%).

Since 1982, natural disaster risks in France have been covered by a national insurance system, paid for by a tax on all households (home and car insurance premiums are increased by 12% and 6% respectively). These solidarity measures only apply when a natural disaster is declared by the mayors of the relevant towns. It should be noted that only a quarter of respondents knew how this system works. Slightly fewer than one respondent in five thought that there was greater than an 80% chance that a storm declared as a natural disaster would occur within the next 15 years on the coast covered by the survey. Around two thirds foresaw worsening storms with a natural disaster declarations in the short to medium term (15–30 years). 44% thought that the solidarity system for natural disasters would be maintained, 26% expected increases to depend on exposure and 31% felt that seafront property would become uninsurable.

Finally, nearly half (41%) of coastal residents stated that their dwelling was located in an area susceptible to flooding, but only a quarter of them felt that they were currently at risk of their dwelling being flooded. A small percentage (12%) had actually experienced coastal flooding of their dwelling.

The majority (65%) of respondents considered the suggested scenarios to be very efficient. During the CE, almost half of respondents (44%) justified their choice by stating that it was a duty to fund managed retreat, whilst 30% always chose the alternative which offered the best value for money. Some 8% refused to pay as they considered that they could not afford it or that the money would be used for something else; only 6% refused to pay because they did not believe in the adaptation scenarios (3% thought there was no point fighting and 3% did not believe in the flood risk).

4.3. Results of the model

The variables used in the model and its results are presented respectively in Tables 3 and 4. Except for “cost” and “ProbaStorm”, all variables are qualitative.

The results show that respondents from the two classes have broadly the same preferences for relocation attributes. They have a strong preference for concerted relocation policies, regardless of what form the concertation takes. They are also all in favour of step-by-step relocation implemented in 15–30 years' time. Class 2 goes so far as to reject policies that would be implemented later (30–45 years). The monetary attribute which was not significant in the conditional logit (one-class model) becomes significant in the latent class logit, with opposite signs depending on the class: negative for class 1 which is therefore in favour of paying a little for a limited relocation and positive for class 2 which is therefore agreeable to a large relocation area at high cost. This result indicates a difference in sensitivity to the scope of the policy from both the spatial scale and the level of the financial effort.

All the variables involved in class membership relate to flooding risk perception. The recollection of violent storms that resulted in natural disaster declarations along the coast covered by the survey is a variable that increases likelihood of class 2 membership. This second class can also be explained by greater awareness of flood risks (i.e. thinking that it may happen within the next 10 years) and by the feeling that a storm leading to a natural disaster declaration is highly probably within the next 15 years. These variables explain membership of the second class, whose members prefer a managed retreat strategy in the relatively short-term and at a significant (spatial and financial) scale. Class 1, on

Table 4
Estimation results.

Attributes and variables	1-class model (a)	2-class model (a)	
		Class 1	Class 2
Utility function coefficient (s.e)			
Moda2	1.03*** (0.08)	1.11*** (0.14)	1.19*** (0.17)
Moda3	0.97*** (0.08)	1.16*** (0.14)	0.98*** (0.16)
Period2	0.40*** (0.08)	0.73*** (0.16)	0.25* (0.15)
Period3	−0.70*** (0.09)	−0.21 (0.15)	−1.47*** (0.22)
Program2	0.47*** (0.06)	0.50*** (0.12)	0.57*** (0.12)
Cost	−0.0001 (0.0004)	−0.01*** (0.001)	0.01*** (0.001)
Class membership function coefficient (s.e) (b)			
Constant	–	0	−0.86*** (0.20)
StormMem	–	0	0.27* (0.14)
SLRInf10	–	0	0.42*** (0.13)
ProbaStorm	–	0	0.01*** (0.003)
FloodArea	–	0	−0.70*** (0.13)
Latent class prob.		0.52	0.48
N	1440	1440	
AIC	2649.37	2436.35	
BIC		2525.98	
Log-likelihood	−1318.7	−1201.2	

Notes: (a) Two-tailed tests show 10% (*), 5% (**) and 1% (***) significance levels. (b) The results should be read “relative to class 1” which is standardized.

Table 5
Profiles of respondents belonging to the 2 classes.

Residents' characteristics	Class 1 (N = 122)	Class 2 (N = 118)
Mean (s.e)		
Age	55.2 (14.5)	52.8 (15.4)
Income	2813.1 (2576.6)	2596.2 (1525.6)
%		
FloodArea*	55.7	41.5
Income < 1300€/month*	23.8	21.2
Income between 1300€ and 3000 €*	47.5	48.3
Income between 3000€ and 4500€*	16.4	21.2
Income > 4500€*	12.3	9.3
Béziers resident*	20.5	29.7
Women	56.6	51.7
Higher occupation socio-economic category*	5.7	12.7
Beach perceived as recreational site for residents	7.4	13.6
Retiree	44.3	40.7
In favour of solidarity criteria*	37.7	49.2
Responsibility of informed owners*	57.4	45.8
Attaches more importance to compensation than to the size of the relocation zone*	55.8	36.8
Considers that flooding is a major consequence of storms*	38.5	28.0
Declares that not personally at risk of inundation*	42.6	32.2

Note: * means that the characteristics are significantly different between the two classes on the basis of a chi-square test.

the other hand, is explained mainly by the fact that individuals state that their dwelling is at risk of flooding. This class is characterized by a preference for a delayed strategy focussed solely on the seafront (and hence not on them).

4.4. Class characterisation

To identify the different classes, we assigned each individual to the class to which they had the greatest probability of belonging. Table 5 shows the main characteristics of these classes.

It is possible to distinguish between classes, by identifying characteristics that vary significantly from one to the other.

The first class includes a large proportion of people who think that their dwelling is located in a floodable zone, and that flooding of seafront housing is a major consequence of storms. While these residents generally tend to own properties at risk of flooding, they often state that they do not feel personally concerned by the risk. The spread of incomes is greater than in class 2 but the average income is statistically identical. The majority of people in this class accept the notion of responsibility in that they tend to agree with lower compensation for informed purchasers. They also prefer concertation on the amount of compensation rather than on the size of the relocation area.

In contrast, the second class is defined by a greater proportion of those with higher occupations, of Béziers residents and of those who put solidarity first as a fairness criterion in the implementation of managed retreat. They are less likely to live in an area exposed to inundation risk. The spread of incomes around the mean is less than in class 1.

4.5. WTP evaluation

Marginal willingness-to-pay (WTP) was calculated for each attribute and for each class (Table 6) and confidence intervals were estimated using the delta method (Hanemann, 1984).

All respondents displayed high WTP to benefit from concertation (because of the positive coefficient of the monetary attribute in class 2, the WTPs of class 2 are expressed in absolute values). Class 1 members

Table 6
Marginal willingness to pay estimates for the 2 classes.

Coefficient (s.e)	Class 1	Class 2
Moda2	116.5*** (19.0)	139.8*** (28.2)
Moda3	122.3*** (18.0)	115.4*** (26.6)
Period2	76.5*** (15.1)	29.6 (19.6)
Period3	−22.4 (16.6)	−172.4*** (31.1)
Program2	52.9*** (13.9)	66.8*** (16.7)

Note: (a) Two-tailed tests show 10% (*), 5% (**) and 1% (***) significance levels.

tended to prefer this concertation to focus on compensation criteria and those in class 2 on the size of the relocation zone. This is consistent with the coefficients of the monetary attribute as we indicated earlier. Both classes were willing to pay €52.9 and €66.8 respectively per household per year for staged policy implementation. However, the two classes exhibited diametrically opposed opinions on policy timing: class 1 residents were willing to pay €76.5 per household per year to implement the policy in 15–30 years' time whereas those in class 2 preferred an immediate implementation, and even stated in some cases that they would need to be compensated (since the corresponding WTP is negative) by as much as €172.4 per household per year to postpone implementation to 30–45 years' time.

5. Discussion

It is noteworthy that no socio-economic variable in our model is significant. In other words, these variables, which in most cases would play a significant role, do not help to explain the heterogeneous nature of preferences when risk-perception variables are taken into account. The literature clearly shows that there is a correlation between risk perception and emotions, as well as highlighting how intuitive reasoning is generally based on familiar analogies (Kahneman and Frederic, 2002). In the case of climate change risk, the powerful influence of different types of perception may be explained by the level of uncertainty and the existence of controversies. For rising sea levels and flooding risks, Taylor et al. (2014) identify numerous studies which show the impact of perceptions on behaviour and the acceptability of adaptation policies (Costa-Font et al., 2009; Alexander et al., 2012; Buys et al., 2012). People who are sceptical about rising sea levels rise are the most opposed to managed retreat. Based on this, it is possible to identify the values behind certain choices (Graham et al., 2014; Taylor et al., 2014; Thomas et al., 2015), i.e. amenities and lifestyles based on being close to the sea, which in turn lead to place attachment and optimism bias relating to rising sea levels.

Taking these phenomena into account makes it possible to adapt awareness-raising measures (Akerlof et al., 2016) and to reduce conflicts (Nivent et Bardsley, 2013) through incentives or compensation mechanisms based on psychological profiles (Graham et al., 2014). Our main hypothesis assumed that physical distance from the coast played the most important role, based on the influence of scale (Akerlof et al., 2016) and NIMBY arguments (Doberstein et al., 2016). However, our results show a greater importance for cognitive distance, as mentioned by Taylor et al. (2014) and the typologies proposed by Graham et al. (2014).

Our 2-class segmentation shows a distribution of respondents according to their real risk exposure and their perception of being at risk. This clearly illustrates the existence of optimism bias. The first class includes mainly (but not only) “at risk” respondents, who, while they are aware of risk, feel (somewhat paradoxically) that they are unaffected by floods. They tend to underestimate risk, and prefer to postpone relocation, restricting it to urban infrastructure located close to beaches (car parks, promenades, roads ….) rather than dwellings. They would rather restrict it as much as possible. They can be

considered to be opposed to relocation, even though directly affects them. People in this class can be qualified as “unaware individualists” in the sense that they favour individual approaches, individual responsibility and significant compensation for a small number of people. On the other hand, fewer respondents in the second class live in dwellings at risk of flooding, but they tend to have greater risk awareness. These individuals may be described as displaying “informed solidarity” in that they are more favourable to solidarity criteria in a managed retreat policy that concerns them mainly through the recreational use of the coast. They can be considered in favour of retreat, the sense that they would like it to happen as soon as possible, and they think it should apply to the largest zones possible.

In much the same vein as the aforementioned literature presented earlier on psychological factors such as emotions and attachment, these results show that it is not the objective and geographical distance from the coast that explains preferences but rather individuals' perceptions of risk, with a significant difference according to whether or not their dwelling is at risk of flooding. Cognitive distance thus plays an important role in structuring preferences relating to relocation policies. The fact that there are more people at risk in class 1 reflects a certain level of optimism bias, in line with other research on risk, both in general and in the case of climate change (Thomas et al., 2015; Taylor et al., 2014; Rey-Valette et al., 2012). The survey undertaken by Guillemot et al. (2014) in Canada goes some way to explaining this, by showing a “comparative” form of optimism bias, in the sense that people underestimate their personal risk and are more worried for their community than for themselves. This disconnection from risk can explain denial, and can lead to less engagement from the very people who adaptation strategies are designed to protect. In the case of climate change and rising sea levels, denial behaviour can be associated with underlying uncertainties and controversies, but also with a feeling of helplessness which leads to fatalism, particularly in older people (King et al., 2014). There may also be stronger psychological resistance, as evidenced in one study looking at 27 cases of relocation (Hino et al., 2017). The partition between the two groups is consistent with the generic opposition observed by Akerlof et al. (2016) between people exhibiting individualistic values, and those more sensitive to the community as a whole.

Our division is also consistent with other typologies highlighting a stronger commitment from people who are sensitive to environmental values and exhibit altruistic behaviour, or who are in favour of more equitable adaptation measures (Adger et al., 2009). For example, Hine et al. (2014) identify four reactions in relation to climate change: engaged, avoidant, optimistic or concerned. Taylor et al. (2014) cite the work of Thompson and Rayner (1998) who use the 4 profiles proposed by Douglas and Wildavsky (1983) - Hierarchists, Egalitarians, Individualists and Fatalists. They explain climate change perceptions according to individual and collective determinants, and show that egalitarians tend to have greater awareness. Similarly, Bellamy and Hulme (2011) note that egalitarians are more concerned about climate change. This is consistent with our class of respondents exhibiting “informed solidarity”.

There is a strong need for awareness-raising and information to ensure the commitment to, and acceptability of, adaptation policies for these risks. Indeed, people are usually more receptive to relocation when it is in response to a natural disaster (King et al., 2014; Hino et al., 2017). However, relocation in such cases only takes place after the event, whereas adaptation strategies generally rely on trying to anticipate future events. While most studies tend to show the impact of risk experience and/or the level of information on the adoption of protective behaviour and preventive measures, it is important to consider how information is transmitted. The effectiveness of public awareness campaigns varies widely (Spiegelhalter et al., 2011), and generally depends on the type of media used and the form of the message conveyed. When a message is based on fear, there is a risk that it will provoke fatalism or inaction when based on (Taylor et al., 2014; Witte and Allen, 2000; Lowe and al., 2006). As well as managing inhabitants' perceptions of risk, it is also important to assist and/or educate elected officials, because institutional inertia can also slow down the implementation of climate adaptation polices (Gibbs, 2016).

6. Conclusion

This research project was funded by the Liteau Program (Ministry of Ecology, Sustainable development and Energy) and the “Contrat de Projet” between the French Government and the Languedoc-Roussillon Region. It aims at assisting decision-makers and promoting interaction and mutual learning between researchers and stakeholders. The objective is to study the conditions for acceptability and feasibility of the sea-level-rise adaptation measures proposed in the new guidelines edited by the French Ministry of the Environment (MEDDE, 2012). Our study intends to inform decision-makers on the potential (dis)agreement points with respect to the implementation of a managed retreat policies and to ensure that decision-makers better understand the determinants in order to implement awareness-raising policies, but identify the incentives or compensation that should be provided. That is the reason why stakeholders were involved in the choice experiment questionnaire design.

Our research contributes to the existing body of studies on the acceptability of managed retreat policies aimed at reducing the vulnerability of coastal areas to rising sea levels. The results of our choice experiment point to the desirability of a rapid and concerted implementation of relocation (in 15–30 years' time). The clear distinction between “unaware individualists” and those displaying “informed solidarity” confirms the significance of values in individuals' choices and behaviour, and therefore on the acceptability of these measures. The main issues are equity and fairness, as found by numerous studies (Glenk and Fisher, 2010; Cooper and McKenna, 2008; Clément et al., 2015).

The originality of our approach resides in the fact that the survey focuses on specific types of relocation, and that it covered a large geographic area, in order to compare people's perceptions and preferences in relation to their distance from the coast. It would appear that it is cognitive distance, rather than the geographical distance, that affects preferences the most. Residents at risk of coastal flooding frequently display an optimism bias that must be taken into account when developing measures to raise awareness. We must notice that our study focuses on the distance from risk as a factor to acceptability of relocation strategy. But we guess one must also take into account the covered distance involved in the relocation process, because the two are not necessarily linked. Given the heterogeneous target audience, incentives and publicity must be adapted to suit all sets of values and levels of education (Taylor et al., 2014; Thomas et al., 2015). The importance that respondents attached to consultation being part of relocation strategy confirms the role played by trust in institutions (Graham et al., 2013; Taylor et al., 2014; Touili et al., 2014; Ledoux et al., 2005; Myatt et al., 2003), particularly since individuals appeared to raise a growing number of issues relating to responsibility and justice (Thomas et al., 2015).

In addition to managed retreat policies, Birkmann (2011) notes the importance of “second order” adaptations. These relate to the financial and social consequences of division over environmental issues, as well as symbolic factors relating to the attractiveness of a given area.

As noted by Gibbs (2016), these multiple issues increase the political risks of relocation, which can vary depending on how pre-emptive it is. In contrast, the philosophy of adaptation relies on anticipation to minimize costs (André et al., 2016).

Acknowledgements

This work was supported by the Liteau Program (French Ministry for Ecology, Sustainable development and Energy) and the “Contrat de

Projet" between the State and the Languedoc-Roussillon Region under the SOLTER project "Territorial Solidarity and Strategies for Coastal Resilience to marine flooding".

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